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INTER-COUNTY RIVER IMPROVEMENT COMMISSION

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INTER-COUNTY RIVER IMPROVEMENT

ANNUAL REPORT OF ENGINEERS

B. P. THOMAS

CHIEF ENGINEER

R. H. THOMSON

CONSULTING ENGINEER

JANUARY 1936

ANNUAL REPORT OF THE ENGINEERS  
INTER-COUNTY RIVER IMPROVEMENT  
FOR YEAR ENDING DECEMBER 1935

TO THE JOINT COMMISSION  
INTER-COUNTY RIVER IMPROVEMENT  
KING AND PIERCE COUNTIES, WASH.

GENTLEMEN:

We, the undersigned, your Chief Engineer and Consulting Engineer, have the honor to join in a report to you treating of the work accomplished on the Puyallup, Stuck and White Rivers during the year just past.

I. WEATHER.

For the month of December <sup>1935</sup> the total precipitation as recorded at Buckley was 4.26 inches, the maximum occurring on the 31st with 0.67 inches falling in twenty-four hours. The temperatures throughout the month were normally low, all of which operated to maintain an extremely low stage of water in the rivers continuously.

Throughout the whole year of 1935 the weather conditions were such as to cause no unusual high stages of water. In fact, not a single high stage of sufficient size to do any damage along the river banks occurred.

II. FINANCIAL.

The total expenditure during the year amounted to \$58,936.57 which exhausted the appropriation. The fact that the emergency appropriation in the latter part of November 1934 was not actually spent until after January of this year somewhat crippled our operations in

in the latter months of the year. The emergency appropriation referred to was made for the purpose of placing rip rap at the Auburn Wall in King County and for the purpose of constructing bank protection at the Briar Patch. The very fact that the authorization for these expenditures came so close to the end of the year that we were unable to complete these jobs until about the middle of January the following year automatically cut us off from the emergency appropriation so that the expenditures actually came out of the regular annual budget. The continued low water and lack of damaging floods throughout the year provided the reason for not requesting additional emergency appropriations to make up the difference.

### III. METHODS OF BANK PROTECTION.

Prior to the incumbency of your present engineers, the principle method of protecting banks was by the use of concrete revetments placed upon the slopes. It was intended that this concrete should reach down to the low water line, but much of the revetment which has been placed had to be constructed during rather high stages of the river so that the toe of the concrete is exposed during periods of extreme low water, some of which extended through several months. Under this system a brush mat from twenty-five to thirty feet wide was laid on the bed of the river extending back under the concrete. Much of the mat has failed because of alternate exposure to air and water. Being placed flat and tied together with heavy cable and wire, it forms too smooth a bed to induce any considerable silting action. The life of the brush mat is, therefore, limited to only a few years and in time becomes a mass of bare poles waving in the current. The smooth face of the concrete

also attracts the main stream to itself by reason of the higher velocity, cuts a deep channel next to the concrete, and deposits bars in the center of the river bed. This combined action soon exposes the toe of the concrete slope to scour underneath and behind it. The natural result produces a progressive failure of the revetment from the toe upward. As has been called to your attention in many previous reports, there are many miles of river bank, particularly in the lower Puyallup, in just this condition.

In an endeavor to save as much of this bank as possible from total destruction, we devised a system of retards. Each retard is constructed of two piling, one placed adjacent to the toe of the concrete and the other at about eighteen foot spacing, and in such position as to form an angle of thirty degrees approximately with the direction of the stream. To the up-stream side of these pilings, bundles of fir brush were fastened, reaching from the bed of the river to a point approximately three feet above normal low water stage. The retards were spaced at approximately thirty to forty feet. The action of these retards is to slow up the velocity of the stream and deposit silt next to the toe of the concrete in such a way as to support it. This system has proved entirely successful.

At the annual meeting of the Joint Board just a year since, the opinion was voiced by your engineers that these retards, if substituted by groins built of quarry rock, would accomplish the same result and be of a more permanent character. Some experimentation has

been conducted along these line during the past year with satisfactory results, in fact, so satisfactory that the current W P A program is designed to use this system.

The discovery and purchase by the Inter-County River Improvement of two quarries within reasonable hauling distance of the river has made it possible to economically place rock on the river banks for protection in competition with the methods heretofore used.

The concrete tetrahedrons tried out during 1934 have proved entirely satisfactory and, as far as effectiveness goes, could be used as rip rap on the banks of the lower river in the reaches where the velocities are not too high. This method proved practical during the C W A and relief work programs by reason of the fact it provided a great amount of hand labor and the required cement was furnished by the government. Now, with rock quarries available, the cost of concrete tetrahedrons is somewhat greater than rock rip rap and is, therefore, not competitive.

Your engineers have been urged time and again to use various types of revetment formed of small concrete blocks bound together by cables or wire linked in such a way as to give considerable flexibility to the entire material. We have consistently refused to adopt any of these systems because of the difficulty in providing permanent and, at the same time, flexible connections between the blocks. The ordinary wire hook that is being used quite extensively is subject to corrosion and will, therefore, be very short lived. To increase the size of these connections, making them proof against corrosion, adds materially to the cost and so much so as to make it prohibitive.

At two points on the right bank of the river in the Auburn Section, we have experimented with strings of skeleton tetrahedrons. These were formed of sixteen foot timbers, six inches by ten inches, bolted together in the form of a four sided figure. They are sometimes referred to as tripods, for the reason, standing on any side, three legs reach upward in the form of a tripod. These tetrahedrons were placed adjacent in a line extending from the bank out and down-stream and roped together with wire rope in such a way as to catch the drift, thus acting as a drift catcher or barrier. In time a sufficient barrier is formed to divert the stream and protect the bank below from scour. The limited experiments argue for greater use of these in the section of the river below the Auburn Wall and above the State Highway Bridge.

#### IV. THE GRAVEL PROBLEM.

During the past year the Improvement has spent about \$7,000.00 in dredging in the County Line Section. As has been amply explained in previous reports, dredging is now concentrated at one location. The operation is necessary because the river deposits its burden of sand and gravel at this point due to a sharp break in gradient.

Some little headway has been gained during the past year against the continuous action of the river. This, however, was a year without floods and it is not to be anticipated that any great margin of headway can be maintained in the long run.

Two questions are frequently asked concerning the flow of gravel. The first question asked is: Can we tell whether a greater or a less quantity of gravel



is being carried by the stream now than in early days? To this question we answer, "Yes". Prior to November 1906, White River divided into two streams at a point about two and a half miles South of and three and a quarter miles East of Auburn. About twenty per cent of the stream flowed along close to the South side of the Valley and made its way into and out of the Stuck swamp. This swamp covered the entire Valley from just about the Pierce County Line, and extended South to within about three-quarters of a mile North of Sumner. Passing out of this swamp it joined the Puyallup a short distance below Sumner. The larger portion of the stream from the point of division flowed closely along the North side of the Valley for about two miles when it turned sharply toward the North. After flowing North about one mile, during normal run off, it was divided into two or three channels, but in flood time it was divided into a multitude of channels. These channels seemed to wander aimlessly over the Valley, but the great majority of them returned so as to form just one stream shortly before combining with the Green. This division into a multitude of channels limited the quantity of water in each channel and thus reduced the velocity of the stream so there was little erosive action after these subdivisions began, also the smallness of the streams killed all high velocity, so that the major portion of gravel and sand was spread out and not carried down stream.

As a result of the flood of 1906, the White, just where it had turned to the North, became choked and the entire flood flow of nineteen thousand cubic feet per second cut its way into the Stuck and plowed out its own

channel down to the Puyallup. In its wild outlaw plowing, it carried hundreds of thousands of cubic yards of earth out of old and new channels and spread it over what had been swamp lands, covering several square miles to depths up to five feet. In order to make the channel change into the Stuck Valley, it was necessary to scour the bed of the White opposite the point at which it had heretofore turned North. This channel deepening increased the drop of the river at that point, and nature ever since has been busy trying to carry out enough sand and gravel from the river bed up-stream, so that the grade would be drawn to the bottom of that drop or scour.

This work of nature was going on when the Inter-County River Commission was created by the Legislature. When taken over by the Commission, the Puyallup was a shallow and crooked stream from Puyallup to the City Boundary of Tacoma, with banks covered with brush and debris all tending to reduce velocity and limit erosion. The popular thought demanded that the river be straightened, and its banks protected. Mr. Paulhamus, a prominent citizen of Puyallup, violently protested the straightening of the channel, and after two years of construction work had been done certain U. S. Engineers from the works on the Mississippi River were called in for conference and report. Under the head of "Straightening of Channel" they reported: "The very radical straightening of the channel and large amount of excavation for entirely artificial channel ways, embraced in the general project of the Board does not commend itself as having been originally necessary to good control of the stream, or economical in cost, nor are the benefits to be gained by such action apparent. In this connection, your attention is invited

to the very wise counsel expressed in the report of the Chittenden Board in the section on "Channel Capacity", pages 19 and 20, which is heartily concurred in." In this Chittenden report referred to, the purport is expressed in just one line of the argument against which the Board had contracted to do, as follows: "The making of cut-offs is a measure that should be resorted to sparingly." Illustrating the wisdom of this remark, evidence was given showing that the cutting off of a long bend on the Mississippi River had caused a change of current and erosive action fifty miles up-stream. However, the Puyallup was straightened and the river bed deepened. The distance from Puyallup to Tacoma City Boundary reduced from six and a quarter to five miles. That work increased the velocity some, but the deepening of the channel at Puyallup produced a second drop, and again changed the grade of the river. As a result of these two drops making grade changes, the river will continue wearing down its bed and carrying its sand and gravel down with every high flood, the quantity being just slightly diminished year by year as the grade is adjusted, but will never cease while flood flows continue, and at all times the smooth concrete banks will continue to increase velocity alongside and thus cause their own undoing.

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This brings us to the second question often asked: Will the river ever adjust itself to grades so as to cease erosion? The answer to this is "No", but the greatest measure of flood damage can be secured by two means. First as to the entire stream, by use of the Mud Mountain Retarding Dam. This will kill all flood action by withholding a vast acreage of water until the

Puyallup watershed has had its greatest run-off, and then paying out so small a current as to hold the height and velocity of the water down to ordinary high water; and second, by placing heavy rip rap along exposed earth and gravel banks, and at the foot of all concrete revetment. The initial cost of some of this work may appear high, but such work is in accordance with sound judgment and of actual economy.

V. THE FLOOD RELIEF PROJECT.

On June the 18th, 1935, we filed with the U. S. District Engineer at Seattle an application for a W P A project for channel clearing and bank protection throughout the whole length of the river. This project was finally approved and works started in December, the total appropriation for the project amounting to \$224,000.00. It calls for the hauling and placing of 32,000 cubic yards of rock to be placed at critical points on the river bank all the way from the city limits of Tacoma to the Auburn Wall. About half of this rock will be used to construct groins at the toe at the failing revetment in the improved sections of the channel. The other major object in the project is to remove and dispose of all the hazardous drift in the White River channel from the County Line to Buckley.

Up to this time the work so far accomplished on the project has been restricted to channel clearing in preparation of roads along the river banks for placing rock and the clearing of a quarry site preparatory to quarrying operations. It is anticipated that the project will continue throughout the summer for a period of time ranging from six to ten months. The project, as it is being prosecuted, is strictly in line with the

plans and specifications drawn up by your Engineers and close contact is maintained between them and the officials in charge. The work is being done under the direction of the U. S. District Engineer's office with Col. H. J. Wild in charge. Mr. Charles B. Smith, under him as Civilian Engineer, directs all flood relief projects. Mr. Lee Johnston is Supervising Engineer of the District including our project and Richard B. Ober is on the job as Supervisor. The project is numbered 65-93-921 for King County and 65-93-918 for Pierce County.

Complying with your instructions a quarry was purchased from Jay Roush on the Kapowsin Road three miles South of Orting. In addition to providing a quarry, the Inter-County River Improvement is furnishing two trucks with drivers, all of its shop facilities, and the close co-operation of its directing organization. We had planned on also furnishing a caterpillar tractor but our machine has been in such poor state of repair that it has put in but few actual working days.

#### VI. STATUS OF THE WHITE RIVER DAM.

The Mud Mountain project, while not having made any considerable headway throughout the year, still remains a live subject. So much so that the whole matter, at this time, will bear of complete review. As you will recall, this project was authorized first at the June meeting of the Joint Board in 1933 after quite exhaustive surveys and complete studies which included the core drilling done at the dam site under competent geological supervision. On October 1st, 1933 an application was filed with the Federal Emergency Administration of Public Works asking that the project be authorized as

a Federal project and funds provided for its construction. In preparation of this application no pains were spared to produce a complete and exhaustive analysis of the subject.

In July 1934, your Board sent your Chief Engineer to Washington City for the purpose of determining the status of the application and the probability of its approval. Finding that the project commanded practically no attention at Washington, he brought the matter before the Chief of Engineers of the U. S. Army, Major Gen. E. M. Markham. Through this move and with the assistance of our Congressional Delegation, authority was provided for immediate review of the project by the Corps of Engineers, U. S. Army. This review was completed after several months of field and office work with the result that a recommendation went forward from Col. C. L. Sturdevant of the Seattle District through Col. Thomas M. Robbins of the Pacific Northwest Division. This recommendation found the project entirely sound from an engineering point of view, worthy economically and of sufficient Federal interest to justify construction by the Federal Government. The Board of Engineers of the U. S. Army failed to concur in these findings and to forward the matter to Congress.

In February of this year your Consulting Engineer was sent to Washington City for the purpose of ascertaining the attitude of the National Rivers and Harbors Congress and also the Natural Resources Board. He prepared the way for the ultimate endorsement by the National Rivers and Harbors Congress. He found the Natural Resources Board to be favorable with the exception of one member. This was Mr. Delano, chairman

of the Board, who stated that the project would command greater interest of the Administration if it combined power with flood control. The futility of such a combination on this project was pointed out.

In April of 1935, Dean R. G. Tyler was sent to Washington City to meet with the National Rivers and Harbors Congress at their annual session at which time this Congress passed on the merits of a number of projects having to do with the rivers and waterways of the United States. Dean Tyler reported in substance, under date of May 6th, 1935, that he had secured the full endorsement of the Mud Mountain Dam project; he further suggested that an application be filed immediately on new forms available as a P W A project.

As a logical follow-up of all of this effort, on June 18th, 1935 an application was forwarded through the U. S. District Engineer's office for the inclusion of the dam in the W P A program. This went forward at the same time as the application for the flood relief project now underway. Great pains were taken to show the U. S. Army Engineers the value of the project as a relief measure and the possibility of harmonizing it, to some extent at least, with the rules laid down by the Administration governing W P A projects. Col. Wild's office at Seattle prepared the formal application and forwarded it to the Division Engineer at Portland with the comment and observation that the project did not fit the program by reason of the fact that the man-year cost exceeded the maximum stipulated. Col. Robbins in the Portland office forwarded the application at Washington with the recommendation that the project be made an exception to the rules and that it was of such

economic merit as to render it worthy of inclusion in this program. The application was turned down by the Board of Engineers at Washington on the grounds that it did not meet with the man-year cost laid down, that it could not be completed by the end of the construction season of 1936, and for the further reason that the Inter-County River Improvement did not own the site.

Subsequently your Joint Board authorized the condemnation of land at Mud Mountain for a dam site and the prosecuting attorney in each County was directed by resolution to start suit for such purposes. The matter of condemnation now lies in the hands of the two prosecuting attorneys.

The only hope for ultimate realization of this project (at least for many years to come) lies in the probability that the Federal Public Works Program will assume such character within the next few months as to permit the inclusion of this project. It is quite evident that the Public Works Program of the Federal Administration will expand somewhat beyond the present conception of the W P A. Bearing this in mind, it is recommended to the Board that no opportunity be lost in the immediate future to drive to fruition all of the effort heretofore spent on this project.

#### VII. CONDITION OF EQUIPMENT.

Attached hereto is an inventory as of July 1, 1935 of all of the equipment and personal property belonging to the Inter-County River Improvement. Your attention is called to the fact that, but for the exception of a few small blocks, cable and one automobile, no equipment has been purchased by your Chief Engineer during the tenure of his office, three years past.



Needless to say, most of the equipment, such as Diesel donkey engines, trucks, caterpillars and such automotive equipment as we have, has lived a substantial proportion of its effective life. A large part of the investment in the equipment by the Inter-County lies in Diesel and gas donkey rigs. This equipment was formerly used for dredging in the river and was kept constantly busy. Under the policy of the present Administration only one of these dredges has been kept in operation and that under a transformed set-up. One of the large 120 H.P. Diesel engines which used to operate as a bagley has been transformed to a slack line rig which operates at the County Line camp. With this equipment, as with most of the other equipment, so little work is required of it that it appears sufficient to meet requirements on the rivers for some time to come. However, this is not true with the caterpillar tractors and trucks.

The condition of the tractors is such that it is almost impossible to keep one in operation. Your Chief Engineer recommended to you a year ago the purchase of a tractor equipped with double drums of sufficient size to handle large logs in clearing the river channel. The need of this piece of equipment has increased with the lapse of the year.

The ton and a half White truck which was purchased in November, 1929, has reached such a state of depreciation as to require that it be replaced at an early date. This truck is a flat bed truck used for general utility purposes in hauling equipment, tools and men. It should be replaced by a truck of not less than equivalent capacity equipped with dual wheels in the rear.

# WHITE RIVER DAM AT MUD MOUNTAIN

The following is an excerpt from the report to the National Rivers and Harbors Congress, with such changes as are necessary to bring it down to date.

This project consists of the construction of a dam on White River for the purpose of storing the crests off of floods. White River is the boundary line between King and Pierce Counties. The dam is to be located about six miles east of Buckley or about thirty miles from Tacoma and forty miles southeast of Seattle.

The estimated cost of the structure complete as designed and computed by the Corps of Engineers, U. S. Army, is \$3,000,000.00. This anticipates the spillway level at elevation 1250, with a storage capacity of approximately 170,000 acre-feet usable.

Protection will be provided for property valued at well over \$100,000,000.00. The extent of this property is shown within the shaded area on the accompanying Vacinity Map. It consists of the developed agricultural lands in the lower White, Green, and Puyallup River Valleys, and the industrial sections on the Tide Flats in Tacoma, as well as those lands along the Duwamish Waterway in Seattle. The principle unit in this project is a thin concrete arch 345 feet high from the stream-bed to the spillway crest and 300 feet long from thrust block to thrust block along the top. Gravity sections at either end of the arch form the thrust blocks for the top rings and either one or both are used as spillway sections, provision being made for a maximum of 30,000 second feet. The arch is designed with a variable radius approaching a constant

angle. It is to be located in a box canyon varying from 100 to 150 feet wide with solid rock walls out-cropping above the top of the structure. The normal flow of the river will be passed through the dam, at the level of the existing stream-bed, through a system of flumes and sluice gates. The discharge during floods will be controlled by a system of high pressure gated orifices so located and designed as to discharge a predetermined quantity of water.

A tunnel about 500 feet long and 15 feet bore will be driven for the purpose of diversion during construction. The construction of approximately one mile of new road-way together with the widening and resurfacing of about five miles of existing road-way is required. Materials for concrete will be developed either from a gravel bar about one and a half miles below the site of the dam or from a glacial deposit about five miles from the site toward Enumclaw. A construction camp will be required on the project.

The Inter-County River Improvement Commission, sponsoring this project, exists by virtue of a contract between King and Pierce Counties as of January 19, 1914, wherein the two counties agreed to permanently divert the White River from its former channel which emptied into Elliot Bay through the Duwamish waterway; the new course being southerly through the Stuck River into the Puyallup which in turn empties into Commencement Bay.

The Inter-County River Improvement has expended money on this work as follows:

RESUME OF EXPENDITURES FOR THE YEARS

1914 to date.

Year	Pierce County	King County	Total
1914	.....	.....	\$ 198,135.48
1915	.....	.....	332,833.93
1916	.....	.....	340,706.85
1917	.....	.....	242,054.92
1918	129,743.25	112,945.82	242,689.07
1919	88,622.15	172,856.40	<u>261,478.55</u>
		ST	\$1,617,498.80
1920	41,040.45	61,314.37	102,354.82
1921	60,703.65	37,508.61	98,212.26
1922	29,081.29	79,558.59	108,639.88
1923	<del>53,477.51</del> 58,146.07	48,566.04	<del>102,043.55</del> 101,712.06
1924	<del>42,035.07</del> 42,042.37	58,063.14	<del>100,098.21</del> 100,105.51
1925	<del>35,511.78</del> 35,466.78	76,656.50	<del>112,168.28</del> 112,123.28
1926	31,410.06	56,374.40	87,784.46
1927	28,609.51	38,216.15	66,825.66
1928	71,667.05	85,148.70	156,815.75
1929	79,225.10	66,339.89	145,564.99
1930	71,946.54	87,311.38	159,257.92
1931	<del>54,163.08</del> 54,163.08	74,885.77	139,048.85
1932	39,902.03	49,944.04	89,846.07
1933	21,768.77	48,483.29	70,252.06
1934	36,998.97	38,080.78	75,079.75
1935	29,088.13	29,978.83	<u>59,066.96</u>
Grand Total			\$3,290,958.27

831,670.26

ANNUAL ECONOMIC BENEFITS.

No accurate record of damage is available prior to 1917. The following table is an estimate of the damage done during the floods since that date. No flood damage surveys are available for these figures, but the most reliable sources were depended upon for them.

Property loss in flood of 1917	\$1,000,000.00
Property loss in floods of 1919 & 21	240,000.00
Property loss in flood of December 1933	
Inter-County Structures	\$325,000.00
State Highway Department	9,000.00
County Roads & Bridges	125,000.00
Tacoma Utilities & Streets	300,000.00
Puget Sound Power & Light	50,000.00
Chicago Mil. & St. P. R.	25,000.00
Northern Pacific Ry.	90,000.00
Industries on Tide Flats	100,000.00
U.S.G.S. Gaging Station	2,000.00
U.S. Engineering Corps	9,000.00
Crops & Agricultural Lands	100,000.00
Live Stock	<u>40,000.00</u>
ST	<u>1,175,000.00</u>
TOTAL.....	\$2,415,000.00
Annual loss over 17 years	140,000.00
Probable saving by I C R I in Maintenance & Operation	<u>60,000.00</u>
Total benefit annually	\$200,000.00

The foregoing table does not include any damage loss suffered by reason of interruption of traffic or mails nor further by the interruption of industrial production and employment nor delays in commerce.

A summary of general or national benefits that might be expended from this improvement follows:

- (a) Protection afforded to the City Waterway in Tacoma against injury due to possible cutting thru or overflow from Puyallup River.
- (b) Decreased cost of maintenance of Duwamish Waterway in Seattle on account of White River having been diverted therefrom and protection to same against a possible return of that river to its old channel.
- (c) Benefit to navigation by preventing tying up of shipping in Tacoma Harbor incident to suspension of operation of railroads during floods.
- (d) Keeping the industrial life of the community functioning and providing employment. Continuous operation of rail lines, water carriers and highways for travel and commerce movements, as well as the uninterrupted flow of men and materials during periods of military operations. Uninterruption of the movement of agricultural products, especially perishables.
- (e) Prevention of possible interruption in transmission of mails.

ESTIMATED ANNUAL OPERATING AND MAINTENANCE EXPENSE

Salaries and wages	\$3,500.00	
Power	400.00	
Materials & Supplies	<u>600.00</u>	
TOTAL OPERATION .....		\$4,500.00

Repairs to Elevator	200.00	
Painting Steel	200.00	
Repairs to Drift Booms	500.00	
Repairs to House & Water Supply	500.00	
Repairs to Drift Removal Equip.	1,000.00	
Repairs to gates	400.00	
Miscellaneous Repairs	<u>200.00</u>	
TOTAL MAINTENANCE .....		\$3,000.00

The Inter-County River Improvement will assume the cost of operation and maintenance of this dam as a unit in its present system.

TABLE SHOWING COMPARATIVE MAXIMUM RUN-OFF  
OF VARIOUS STREAMS IN WESTERN WASHINGTON.

RIVER	STATION	DATE	DRAINAGE AREA	FLOOD DISCHARGE	RUN-OFF PER SQ. MILE
	(At or Near)		Square Miles	(Second Feet)	(Second- Feet)
Puyallup	Puyallup	Dec. 18, 1917	914	40,500	44.31
"	"	Dec. 10, 1933	914	57,000	62.36
Skykomish	Gold Bar	Feb. 26, 1932	535	74,400	139.06
"	"	Dec. 21, 1933	535	78,800	147.29
Snoqualmie	Tolt	Feb. 26, 1932	605	51,000	84.30
Skagit	Concrete	Feb. 27, 1932	2700	147,000	54.44
"	"	Dec. 13, 1921	2700	240,000	88.89
"	"	1856	2700	350,000*	129.62*
"	"	1815*	2700	500,000*	185.18*
Chehalis	Grand Mound	Dec. 21, 1933	928	45,000	48.49
Nisqually	Alder	Feb. 26, 1932	250	14,600	38.40
"	LaGrande	Dec. 12, 1921	287	19,500	67.94
Cowlitz	Castle Rock	Dec. 23, 1933	2210	139,000	62.90
Lewis	Ariel	Dec. 22, 1933	733	129,000	175.99
South Fork Stilaguamish	Arlington	Feb. 26, 1932	254	35,000	137.80
North Fork Stilaguamish	Arlington	Feb. 26, 1932	282	27,700	98.23
Cedar	Landsberg	Dec. 22, 1933	136	7,860	57.79
Green	Headworks	Dec. 9, 1933	231	33,600	145.45

\* Taken from estimates given in U.S.G.S. Water-Supply Paper 612, page 62

The maximum discharge recorded in the Puyallup is in the lower bracket of all the streams draining the western slope of the Cascade Mountains. The records cover a comparatively short period. All factors considered, it is highly probable that a flood exceeding the one of December 1933 by forty or fifty per cent will occur at some future date when the right combination of very deep <sup>new</sup> snow lying on the mountains occurs simultaneously with a warm Chinook wind and a heavy precipitation. A study of flood records reveals that the place of maximum intensity of discharge moves up and down the Cascade Range for different flood producing periods, it showing the highest run-off per square mile now on this stream and again on another stream at a different flood period. Those streams now in the lower brackets are sure to have floods with higher run-offs recorded some day.



EXPENITURES FOR THE MONTH OF  
DECEMBER 1935

ITEM		AMOUNT ALLOWED	TOTAL EX- PENDED PRE- VIOUS MONTHS	TOTAL EX- PENDED IN DECEMBER	TOTAL EX- PENDED TO DATE
Buckley Section	1	\$1,000.00	.....	.....	.....
Muckelshoot	" 2	1,000.00	...43.12	163.44	206.56
Auburn	" 3	2,000.00	18,084.30	124.93	18,209.23
County Line	" 4	10,000.00	6,705.02	480.73	7,185.75
Dieringer	" 5	6,000.00	4,750.77	.....	4,750.77
Roesli	" 6	4,000.00	1,204.17	14.85	1,219.02
Puyallup	" 7	4,000.00	395.74	.....	395.74
Murphy	" 8	4,000.00	3,025.26	33.23	3,058.49
Reservation	" 9	4,000.00	1,676.90	301.35	1,978.25
Gen. Control	" 10	12,000.00	12,455.65	905.73	13,361.38
Plant Equipment	11	12,000.00	9,180.49	382.12	<del>2,701.77</del> <del>9,562.61</del>
Stock Account	12	....1....	- 720.00	- 78.97	- 799.07
		60,000.00	56,801.32	2,327.41	59,128.73
Dec. 1934 Acct., Chgd. January 1935, not paid to Hunt & Mottet					61.77
					59,066.96
		Pierce	King	Totals	
Budget Levy		\$28,000.00	\$30,000.00		
Rev. Fund		1,000.00			
Revenues		336.50			
Nov. Gas Refund		4.65			
Dec. Gas Refund		9.70			
		29,350.85	30,000.00	59,350.85	
Forw'd Nov. Stat.	\$27,907.77				
Rev. Fund Credit	250.00				
Exp. to 12/1/35	27,657.77		29,081.78		
Exp. Dec. 1935	1,430.36		897.05		
Total for 1935		29,088.13	29,978.83	59,066.96	
Unexpended Balance		262.72	21.17	283.89	
Revolving Fund		250.00			
Total Unclaimed drafts on fund		231.73			
Balance of fund		18.27		18.27	
Total Unexpended Balance				302.16	
Amount paid to King County Employees prev. months \$18,597.43					
" " " " " "			December	869.77	
" " " " " "			to date		\$19,467.20
" " " Pierce " " "			prev. months	20,150.79	
" " " " " "			December	1,046.63	
" " " " " "			to date		21,197.42
" " " Both County " "			to date		\$40,664.62

*B. P. Thomas*  
B. P. Thomas, Chief Engineer  
Inter-County River Improvement